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# SULPHUR IN NOVA SCOTIA: PUGWASH AND HILDEN OCCURRENCES

by

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**Preface**

This report is a brief introductory outline of a comprehensive report on the potential for bioepigenic sulphur occurrences in Nova Scotia. Detailed petrographic work, geochemical and isotopic analysis are in progress.

**Introduction**

Worldwide, all commercially important deposits of elemental sulphur originated as bioepigenetic replacements of anhydrite or gypsum. These deposits occur in two distinct geological settings; (1) cap rock deposits overlying salt diapirs and (2) stratabound deposits within evaporite deposits. Examples of cap rock deposits occur in coastal salt domes of the Gulf Coast Basin in Texas, Louisiana and southern Mexico and examples of stratabound deposits occur in the Delaware Basin of west Texas and the Mesopotamian Basin of northern Iraq.

Elemental sulphur deposits have a number of common characteristics; they are associated with dominantly marine evaporite sequences in sedimentary basins where structural controls (i.e. joints, faults, etc.) have supplied extensive plumbing to allow for the mixing and flushing of artesian meteoric water systems through hydrocarbon bearing strata and the evaporite deposit. This flushing encouraged the proliferation of sulphate reducing bacteria, most probably Desulfovibrio desulfuricans which obtains energy through the oxidation of hydrocarbons. This metabolysis releases hydrogen sulfide as a byproduct which can then be oxidized to produce elemental sulphur. Biogenic calcite is also a byproduct of the bacterial breakdown of gypsum or anhydrite. Documentation of this process can be based on $^{34}S$ and $^{13}C$ fractionation data.

Sulphur exploration in Nova Scotia reached a peak in 1966-1967 when two companies, Scurry Rainbow and New Senator/Peel Elder actively undertook exploration programs. Scurry Rainbow drilled shallow wild cat holes to access five Windsor Group related gravity lows but had poor results. New Senator/Peel Elder focused exploration drilling on the Hilden prospect.

**Hilden Occurrence**

The Hilden sulphur occurrence is located near the northeastern margin of the Shubenacadie Basin (see Fig. 1). The geology of this area is complex and not well defined. The proximity of the area to the major faulting of the Minas Geofracture and documented faults in the southern portion of the Shubenacadie Basin suggest that complex faulting is probable. Hydrocarbon shows, particularly bitumen, are locally abundant near the Horton-Windsor contact especially near Walton 50 km to the west. $H_2S$ has been reported in drillholes into the Windsor Group evaporites. Bitumen and $H_2S$ are generally associated with the sulphur at Hilden.

Horton Group siliciclastic rocks outcrop to the north of the disturbed sulphur bearing gypsum and anhydrite outcrop area. Presumably younger Windsor Group evaporites and carbonates occur to the south. The Horton/Windsor contact zone is disrupted by faulting and solution collapse.

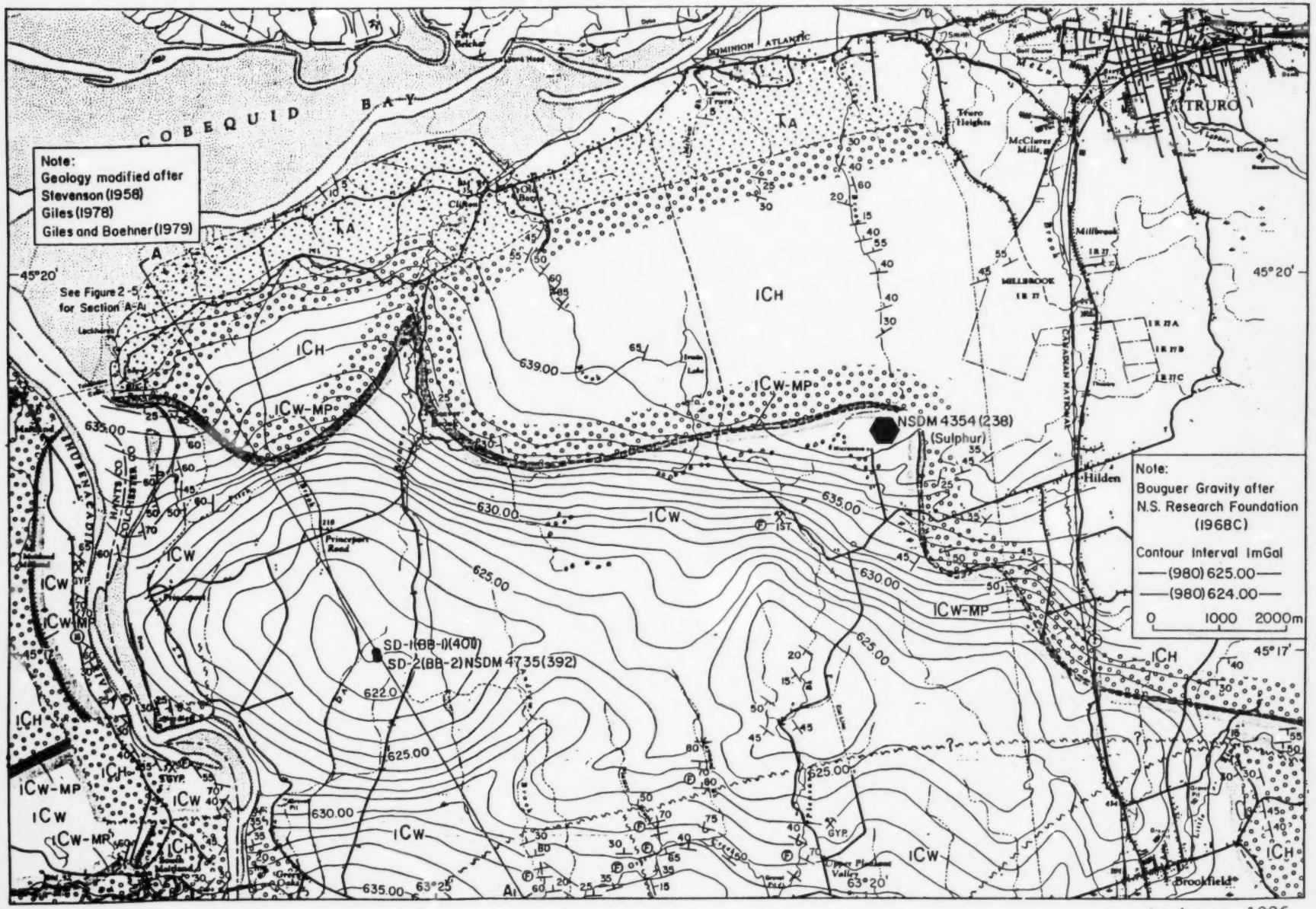


Figure 1.

Boehner, 1986

The basal anhydrite unit of the Windsor Group appears to be the host for the sulphur. The southward extension beneath the upper Windsor Group, and the westward extension of the outcrop belt have not been established. Despite these unknowns, the presence of elemental sulphur in this stratabound situation indicates that conditions necessary for the formation did exist at this location, at least on a limited scale.

A second elemental sulphur occurrence, from a similar stratigraphic position has been reported at Dingwall, Victoria County.

**Pugwash Occurrence**

The Pugwash sulphur occurrence has recently been noted in the underground workings at the Canadian Salt Co. salt mine (see Fig. 2). The Pugwash salt deposit is located in the Cumberland Basin, a large structural subbasin transected by two, east-west trending, evaporite cored anticlinal structures. Recent work on the structure and stratigraphy of the Pugwash mine indicates that the deposit is a piercement diapir and suggests that some percentage of the original deposit has been removed by surface exposure and/or groundwater interaction. Extensive flowage, folding, boudinage and passive rafting of anhydrite and halite units within a halite matrix, combined with the attenuation and elimination of parts of the sequence has resulted in a complex series of steeply dipping anhydrite units interstratified with and isolated in a halite matrix.

The anhydrite units exposed by the mine workings can be identified and correlated, one of which has been informally termed the third anhydrite (see Fig. 3). This anhydrite contains minor amounts of elemental sulphur which occurs as a thin film with carbonate mud surrounding anhydrite nodules. It is notable that this anhydrite unit occurs on the northern mining limit of the deposit, on the uppermost mining level and that it is in direct contact with hydrocarbon bearing clastic rocks.

Cap rock is a term applied to the material which immediately overlies the crest of a salt stock, dome or diapir and drapes down the uppermost flanks. It is generally believed to have been formed by the residual accumulation of insoluble material, dominantly anhydrite, during salt dissolution. Although only limited documentation of the cap rock overlying the Pugwash salt deposit exists, and do not include elemental sulphur showings, the presence of hydrocarbon bearing clastic rocks adjacent to the diapir, minor hydrocarbon showings within the evaporite and the presence of minor amounts of elemental sulphur confirm that conditions necessary for elemental sulphur deposition did exist, at least on a limited scale.

**Discussion**

Conditions necessary for the bioepigenic formation of elemental sulphur appear to have been met within the Windsor Group evaporites in Nova Scotia at least on a limited scale. Further work on the known occurrences at Hilden, Dingwall and Pugwash will establish the parameters necessary to assess the potential for sulphur deposits elsewhere in the province.

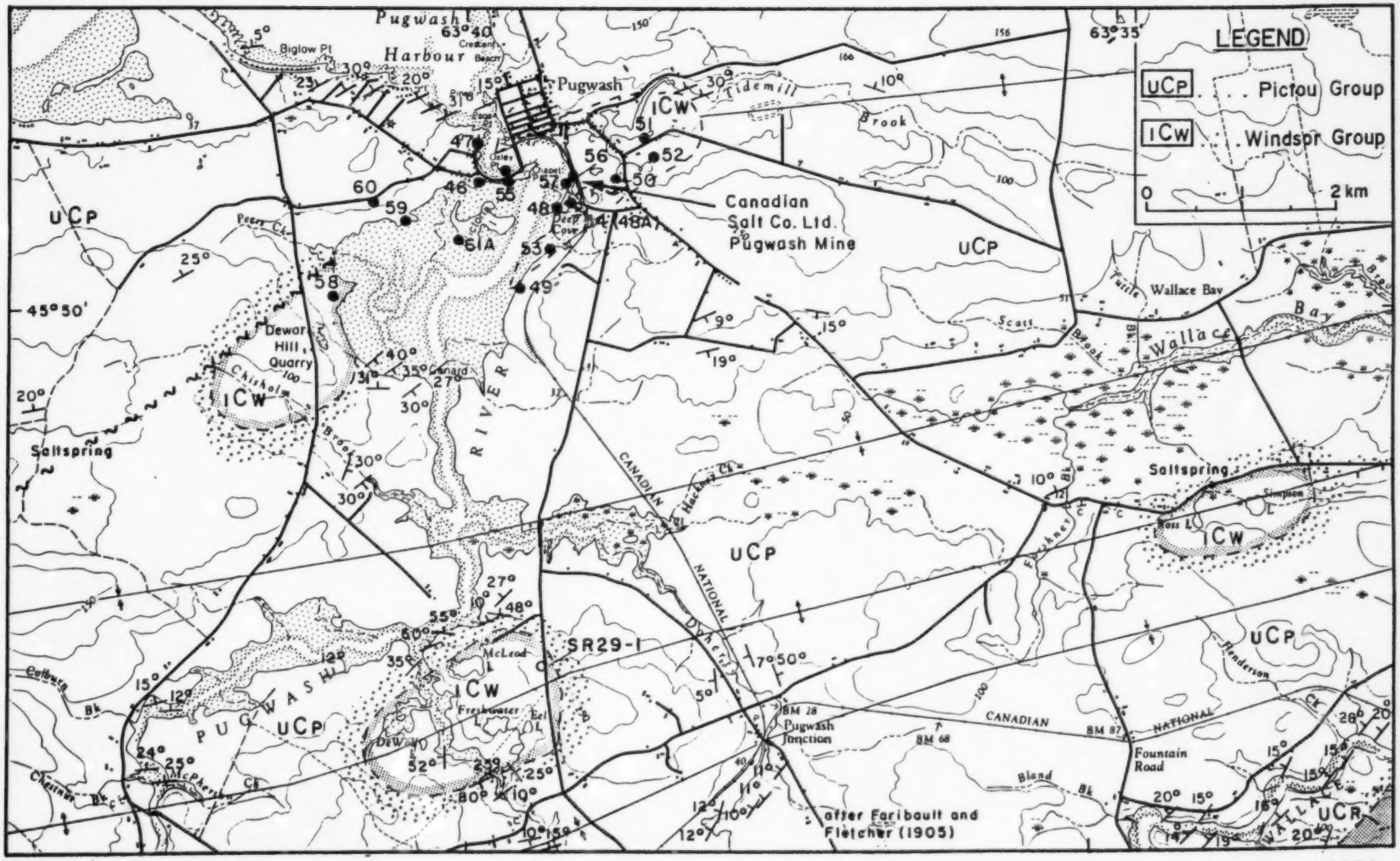


Figure 2.

Boehner, 1986

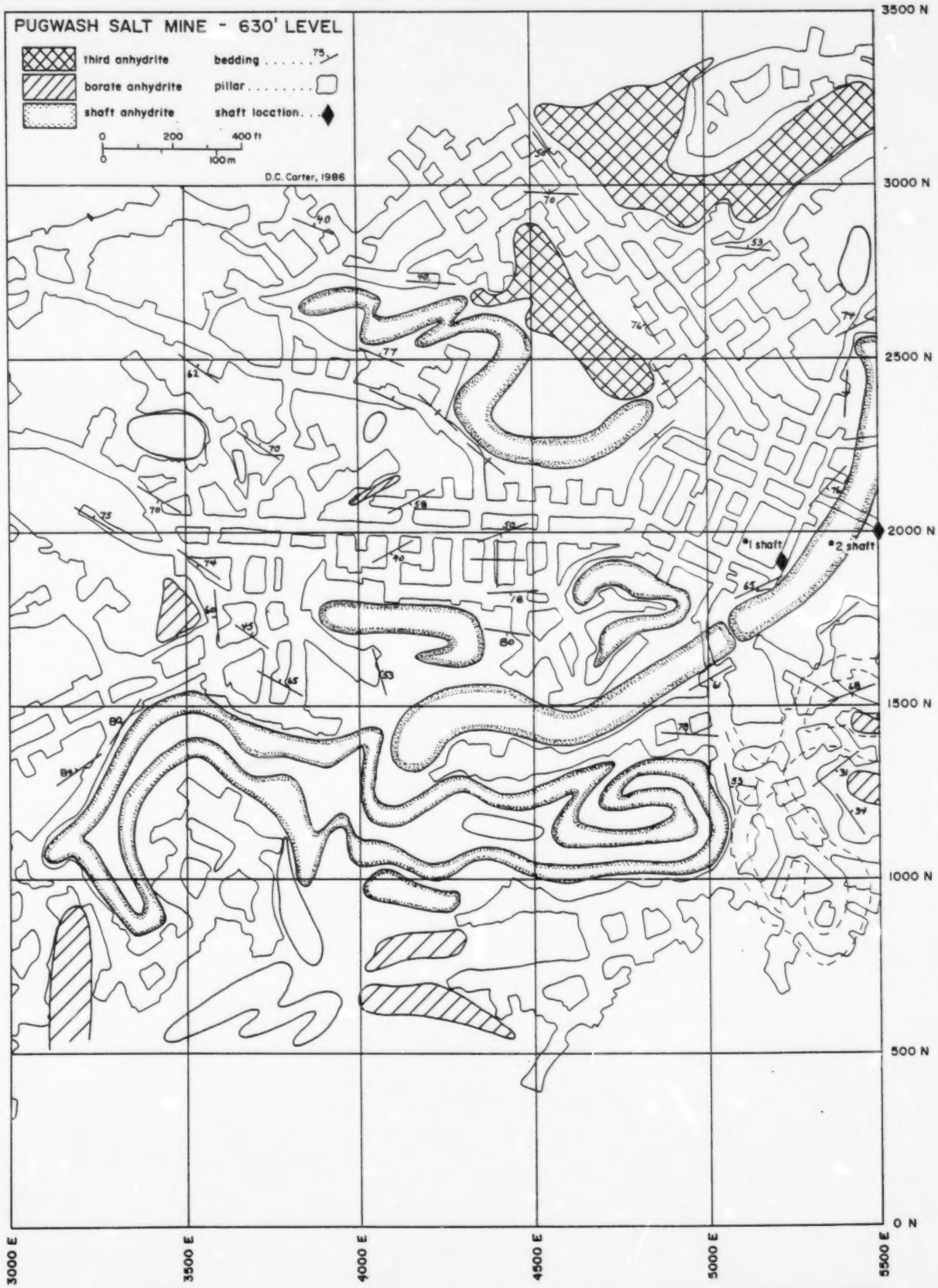


Figure 3. Carter, 1986

According to a British Sulphur Corp. market balance assessment (Sulphur 181., Nov-Dec 1985): "The most important and marketable producers' stockpile is in Western Canada. At end-1984 stock held in block totalled 11.7 million tonnes, which could meet the deficit 1985-1990 of a cumulative total of 10.15 million tonnes, but which would then be near exhaustion.

Stocks elsewhere in the world are significant in the United States and in France, with 2.3 and 1.8 million tonnes respectively at the end of last year. Liquidation of French, Canadian and some US stocks will be adequate to meet even the most pessimistic deficit forecast to 1990, but only until then.

The major conclusion is therefore that sulphur will be in short supply for the rest of the decade. Present sulphur supply sources and stocks will probably be adequate to meet deficits up to 1990, but on a worst-supply case where Soviet Union sulphur does not materialize on the currently expected scale, by 1990 stocks will be close to zero facing an on-going deficit of close to 3 million t/a. It would therefore appear advisable that the quest for new sulphur supply sources be pursued with urgency."

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